

IMMUNOSTIMULANTS USED IN AQUACULTURE

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HIGHLIGHT POINTS:

Fish farming constitutes unique and significant berth in industrial scale production worldwide.

Due to intensive fish farming practices, infectious disease poses a major problem in aquaculture industry globally especially causing heavy loss to farmers.

Various types of antibiotics, chemotherapeutic and vaccines are in use to control or prevent viral, bacterial, parasitic and fungal diseases.

The use of adjuvants or immunostimulants is good remedy to increase the vaccine efficacy to control fish and shrimp diseases. Immunostimulants (IS) is a naturally occurring compound that modulates the pathogens via facilitate the function of phagocytic cells and also stimulate the natural killer cells (NK), complement, lysozyme and antibody responses of fish.

INTRODUCTION

World wide aquaculture systems are subjected to many diseases like bacterial,

virus, fungal and parasites that lead to great economic losses and decrease in fish production. The use of immunostimulants in aquaculture systems for prevention of diseases is a promising new development. It is may be defined as the agent, which stimulate the non-specific immune mechanisms on their own or specific immune mechanism when coupled with an antigen. In general, immunostimulants comprise a group of biological and synthetic compounds that enhance the non-specific defense mechanisms in fishes, thereby imparting generalized protection. Immunostimulants promote a greater and more effective sustained immune response to those infectious agents (viruses, bacteria, fungi, and parasites), producing subclinical disease without risks of toxicity, carcinogenicity or tissue residues.

The immunostimulants enhance the level of duration of specific immune response, both cell-mediated and humoral, following vaccination. Immunostimulant supports to overcome of immunosuppressive effects of stress and of those infectious agents that damage or interface with the functioning of cells of immune system. A variety of substance have been shown to have the immunostimulatory effects which are microbial derivatives, plants or animal extracts, vitamins, hormones and synthetic chemical but Herb extracts and animal originated product have a potential application as an immunostimulant in fish culture, primarily because they can be easily obtained, are not expensive and act against a broad spectrum of pathogens.

IMMUNOSTIMULANTS

The use of immunostimulants as an alternative to the drugs, chemicals and antibiotics currently being used to control fish diseases in aquaculture is attracting the attention of many researchers. In this context, many have focused on the

use of medicinal plant and animal originated products as potential therapeutic measures

for modulating the immune response to prevent and control fish diseases without recourse to antibiotics and chemotherapeutics. Application of immunostimulant alone or together with vaccination has emerged as one of the more promising approaches to prevent or control fish diseases. The use of immunostimulant, as dietary supplements, can improve the innate defense of animals providing resistance to pathogens during period of high stress, such as grading, reproduction, sea transfer and vaccination.

THE USES OF DIFFERENT TYPES OF IMMUNOSTIMULANTS IN FISH

CULTURE

1. Levamisole, an anthelmintic used for treatment of nematodes in man and animals (Synthetic Chemicals): Levamisole is enhancing metabolic and phagocytic

activation of neutrophils and increase the number of phagocytes and leucocytes and the level of Lysozyme. In Coho salmon, it increases resistance against *Aeromonas salmonicida* infection, In carp, it enhance phagocytic activity, myeloperoxidase activity in neutrophils, increase leukocytes number and serum lysozyme levels.

2. FK-656 (Hepatonoyl-γ-glutamyl-(L) mrsodiaminopimely-(D)-alanine is a peptide Related to lactoyl tetra peptide (Synthetic Chemicals). FK-656 has been shown activity against microbial infection. It increases the resistance of Rainbow trout against *A. salmonicida*. In Yellow tail, it elevates humoral antibody titers and splenic producing Antibody.

3. MDP (Muramyl dipeptide) N-acetylmuramyl- L-alanyl-D-Isoglutamine), derived from Mycobacterium (Bacterial derivatives). It activate macrophages, B lymphocytes and alternative pathway of complement. MDP increase the phagocytic activities, respiratory burst and migration activities of kidney leucocytes as well as

resistance of the fish to *A. salmonicida* challenge.

4. LPS (lipopolysaccharide) is a cell wall component of Gram-negative bacteria

(Bacterial derivatives). LPS stimulate B cell proliferation and enhance macrophage

phagocytic activity.

5. Vibrio Bacterin (Bacterial derivatives). It increases protection in Rainbow trout

against *V. anguillarum*. It has immunostimulant effects in Kuruma prawns and black tiger.

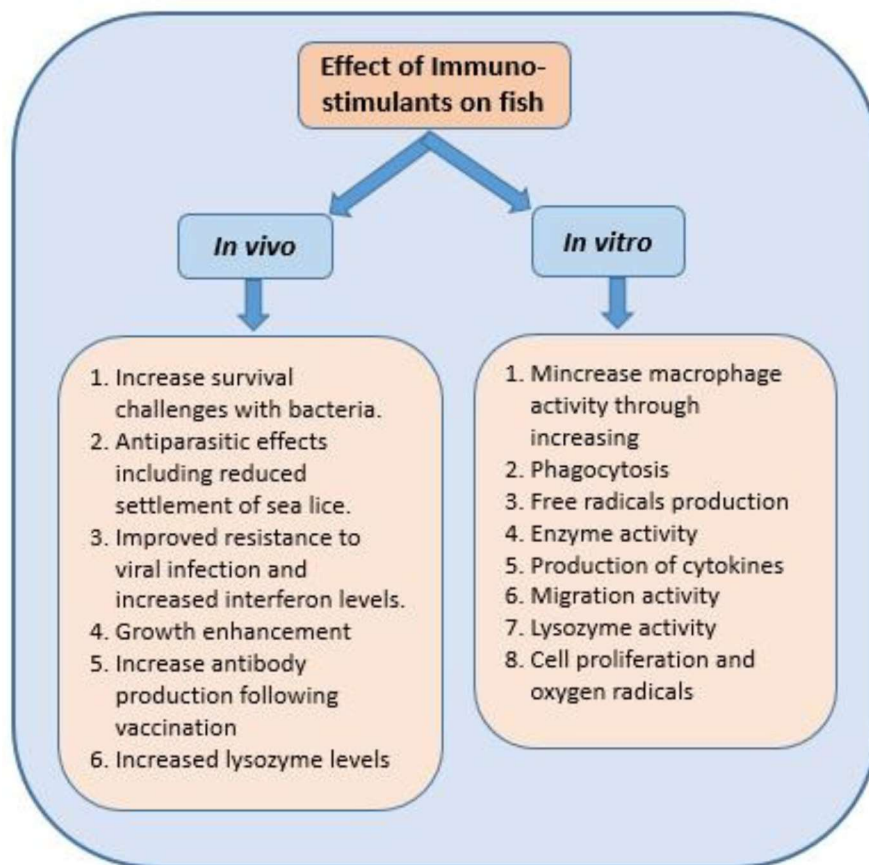
6. Animal Extracts from marine tunicate, glycoprotein fraction of water extract from abalone, *Haliotis discus hannai* (Biological Substance). It enhances killing of tumor cell and inhibited tumor growth *In vivo* and stimulate phagocytosis and increased survival of eel against *A. hydrophila*. It increases production of superoxide anion, potential killing activities by macrophages and lymphoblastic transformation of lymphocyte *in vitro*.

7. Vitamin E (Nutritional Factor), enhances both humoral and cellular defenses in

mammals. Specific and cell mediated immunity and macrophage phagocytosis in rainbow trout. It increases phagocytic indices and superoxide anion production

by leucocytes.

8. Cytokines are polypeptides or glycoproteins. Cytokines act as modulators in the immune system. Cytokines such as Interleukin-2 reported as immunostimulants.



reducing fish mortality challenge with *Edwardsiella ictaluri*. Immersion method is very effective during acclimation of juveniles to ponds in field condition. Using immersion of levamisole showed increase in circulating leukocytes, phagocytic rate and increase protection against *P. damsela* sub sp. *piscicida* in European Seabass.

Mode of action:

The mode of action of immunostimulants is to activate the immune systems of

organisms, to enhance the immunity level against invading pathogens.

Major responses in fish treated with an immunostimulants

Method of administration:

Immunostimulants potentiate the immunity of the host itself, enabling it to defend more strongly against pathogens. Several immunostimulants also stimulate the natural killer cells, complement, and lysozyme and antibody response of fish. There are mainly 3 ways to deliver immunostimulants including injection, immersion and oral uptake. Injection of immunostimulants can produce strong non-specific response but its costly affairs with lots of time and labour intensive as well, applicable only for large size of fish more than 10-15g in body weight in intensive aquaculture system. It has been reported that injection has wide protection against a range of pathogens like intra-peritoneal injection with glucan injected to channel catfish shows increased in phagocytic activity

Following are some of the mechanisms of actions:

- Stimulators of T-lymphocytes- Levamisole, Freund’s Complete Adjuvant (FCA), Glucans, Muramyl dipeptide, FK-565 (Lactoyl tetrapeptide from *Streptomyces olivaceogriseus*).
- Stimulates of B-cells- Bacterial endotoxions, Lipopolysaccharides.
- Macrophage activator- Glucans, Chitin and Chitosan
- Inflammatory agents including chemotoxins
- Cell membrane modifiers- Detergents and Sodium dodecyl sulphate, Quaternary ammonium compounds (QAC), Saponins
- Nutritional factors- Vitamin C and E, n-3 fatty acids
- Cytokines- Leukotriene, Interferon
- Heavy metals- Cadmium

- Animal and fish extracts- Mitogens

CONCLUSION

Immunostimulants appear to be most promising and useful tools for prophylactic treatment of farmed fish and shrimp. It is safer than chemotherapeutics and their range of efficacy is wider than vaccination. However, these compounds will not replace vaccines proper nutrition or good management techniques. The strength of these compounds appears to lie in their ability to enhance larval culture before the specific immune system matures and the animals can be vaccinated and able to improve nonspecific immune function against a broad spectrum of pathogens.

SABUJEEMA

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